Refinery Cooling Water System Maintenance Problem Solved With Hot-Tap Insertion Mag Flow Meter

Case Study

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A large oil/gas refinery located in the Southern US along a major river utilizes water from the river for process cooling in its operations. A large amount of water is used in the refining process by the plant that must be treated after use in the plant and then returned to the river. An accurate and low maintenance flow monitoring system is essential to keep water intake, treatment and return operational costs as low as possible.

The US EPA requires that the plant must monitor all raw water intake from the river and treated water outflow back into the river from the plant for pollution monitoring purposes. Inflow is metered just after the water passes through the cooling system, while outflow is measured as treated refinery wastewater prior to re-entering the river. Accurate measurement ensures the plant meets all water quality regulations to avoid audit problems and potential fines.

The refinery initially relied on spool-piece electromagnetic flow meters, but their high maintenance requirements necessitated the frequent shut down of the water line to remove the meter for cleaning and component replacement, which incurred significant maintenance crew, maintenance equipment and spare part costs.

Problem: High-Maintenance full-bore Mag Meters Require Full Line Shutdown

The refinery's full-bore electromagnetic flow meters supported flow measurement in both 36- and 42- inch water lines. The full-bore meters became dirty easily, leading to electronics drift problems and unreliable measurement accuracy. The meters needed periodic cleaning, which required shutting down the lines, removing the meters with heavy equipment crews, cleaning them and replacing parts as necessary. The meters then had to be re-inserted into the line followed by a re-start sequence for the line.

This maintenance process was cumbersome and expensive to ensure accurate meter readings with a high level of confidence. In addition, the line shutdowns affected plant throughput productivity and impacted profits. In searching for a lower maintenance solution, the plant operations team contacted the applications group at McCrometer to discuss potential alternative flow metering solutions.

Solution: Hot Tap Insertion Style Mag Flow Meters

After reviewing the application requirements, McCrometer recommended its full profile insertion multi-electrode mag meter.

Fig. 1: FPI MagTM Full Profile Insertion Flow Meter

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Designed to be installed (or removed and serviced) without shutting down or cutting the line and without heavy equipment, the FPI Mag™ Flow Meter provides an exceptionally low installed and life-cycle cost.
Hot tap insertion allows the flow meter to be installed without interrupting service, de-watering lines, cutting pipe or welding flanges.

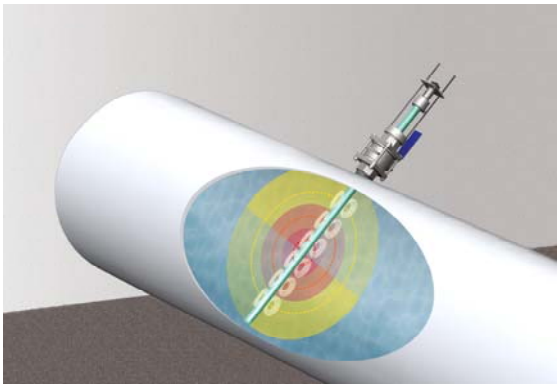

Fig. 2: FPI Mag Installed In Pipe

The flow element can be removed from the line without shutting down water flow, cleaned, inspected, calibrated or verified with a simple process and then replaced without an expensive line shutdown and re-start sequence.
Hot tappable, insertion-style flow meters such as the FPI Mag that don't require shutting down the line are cost-effective in the oil refining industry, where production targets and profits are measured in the billions of gallons of refined product. This meter's compact insertion design with precision multi-electrode sensing and measuring technology fits extremely well into crowded plant retrofit or expansion projects. It also offers total accessibility without the need for heavy equipment and extensive manpower.
Already low maintenance, this electromagnetic meter is also packaged in heavy-duty 316 stainless steel for maximum structural integrity. The sensor itself is coated with a 3M fusion-bonded epoxy coating for operational longevity. With no moving parts and a single-piece design, the FPI Mag flow meter contains nothing to wear or break and it is generally immune to clogging by grit or other debris. In addition, the flow sensor comes pre-calibrated from McCrometer's NIST traceable Calibration Lab and requires no recalibration in the field.

In addition to forward measurement, this flow meter can be configured to provide bi-directional measurement, which is important in many applications. Bi-directional flow capability helps users with complex, problematic piping configurations. Valuable flow data can now be gathered where measurement was previously cost prohibitive, such as areas affected by multiple expansions and retrofits or locations where two or more pipes converge and are consolidated into a single line

FPI Mag Meter Principal of Operation and Multi-Electrode Flow Sensing

The unique operating principles of the FPI Mag Full Profile Insertion Flow Meter deliver accuracy unmatched by other insertion mag meters and rival the performance of full-bore mag meters. With precise measurement, the FPI Mag flow meter features accuracy of ±1% of reading ± 0.03 ft/s zero stability from 0.3 to 20 ft/s velocity range for forward flow and accuracy of ±1% of reading ± 0.03 ft/s zero stability from -0.3 to -20 ft/s velocity range in reverse flow. It is suitable for use in lines from 4 to 138 inches.
The meter operates based on Faraday's law of electromagnetic induction, which states that a conductor, moving through a magnetic field, produces a voltage. Because water is a conductor, water moving through a magnetic field produces a voltage. The magnitude of the voltage is directly proportional to the velocity at which the water moves through the magnetic field.
The FPI Mag's streamline sensor features multiple electrodes across the entire pipe diameter. Electrode pairs are located so that each pair measures an equal cross-sectional area.

The velocity measurements are added and averaged, providing an area-weighted average velocity across the pipe's centerline. Flow is then calculated by multiplying the average velocityby the cross-sectional area of the pipe. Continuous measurement across the entire flow profile compensates for variable flow profiles, including swirls and turbulent conditions.

Full profile, multi-electrode measurement is especially useful in lines where irregular flows occur. Crowded plant layouts, including pumps or valves as well as pipe elbows are often

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contributors to these types of irregular flow. While it might sound simple enough to move the flow meter to another measurement location, the reality of existing plant conditions often dictates otherwise and forces the placement of flow meters in less than optimal locations.

Conclusion

The refinery's flow measurement process was greatly improved by the switch to McCrometer's FPI Mag Full Profile Insertion Flow Meter with its simplified and inexpensive installation process, hassle-free cleaning and maintenance, and most importantly, the fact that process operations never have to shut down the line to clean or change out the meter. Its use is especially economical in large pipe sizes such as those being metered at the refinery, reducing installed costs by more than 45 percent. The refinery staff has found the solution to be so cost-effective that it has continued to use the multi-electrode hot tap FPI Mag insertion-style flow meters in its cooling water processes for the past nine years.

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